Great Lakes Dredge & Dock Company

Revised Capping Plan For Geotextile, Armor Stone & Habitat Layer Installation

Lower Passaic River Study Area Project
Dredging / Solidification / Capping Services

Capping Plan rev9			
DREDGING, STABILIZATION AND CAPPING RIVER MILE 10.9 TCRA			
Submittal Number:	4	Specification Number:	02 32 00
		Paragraph :	1.03
GLDD Reviewer:		Tim Briggs	
Date of GLDD Approval:		01/13/2014	
We certify that the submittal has been reviewed, checked and approved for compliance with the Contract Documents			

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1.0 Introduction

Following the installation of the Sand/AquaGate+PAC™ layer on the Lower Passaic River Mile 10.9 Project Cap, Great Lakes Dredge and Dock Co. LLC (GLDD) encountered difficulties with the previously proposed/selected installation techniques associated with the geotextile and armor stone layers due to the tidal currents and the underlying soft layer of sand/active material. As a result of these site conditions, GLDD has revised the Capping Plan to address these conditions and provide an improved method for the installation of the geotextile and armor stone. The revised plan will potentially use two geotextile deployment methods. One method will be deploying the geotextile from a barge using a sinking bar arrangement. The second method uses a structural panel to deploy the geotextile. This Revised Capping Plan will describe both of the revised means and methods for the installation of the geotextile and armor stone layer, along with the placement of the habitat layer.

2.0 Capping Equipment/Personnel

2.1 Equipment

The Capping Phase requires specialized equipment for the placement of the Geotextile, Armor Stone and Habitat Layer. Most of the specialized marine equipment used during the Dredging Phase will be re-purposed and re-configured for employment during the Capping Phase. Additional material barges and a deck barge for the geotextile have been added for the placement of the geotextile and armor stone. The following equipment is planned to be used during the Capping Phase:

Project Equipment
1-Crane or Material Handler
1-Geotextile Frame
1-Sinking Bar Assembly
2-Material Transport Barges
1-Modified Dredge Barge
1-Capping Deck Barge
2-Deck Barges
1-Telebelt TB 130 Mobile Belt Conveyor
1-CAT 324 Long Reach Excavator
1-2-Bin Feeder/Incline Belt Conveyor
1-RTK/GPS Positioning System
2-2400 Hp, twin screw Tugboats w/operators
1-450 Hp, twin screw Tugboat w/operator
1-Sealand Container w/generator-office
1-Sealand Container-spare parts
1-Survey Boat
Spud winches/Power Pack
Signage/Navigation Lighting
Portable Sanitary Facilities
Truck with truck mounted winch

Equipment illustrations and specifications have been included in the original Capping Plan and have not been included in this revised plan for brevity.

2.2 Key Personnel

Project Manager- Mr. Rich Anson

Mr. Rich Anson is proposed as the project manager for the Capping Phase. Mr. Anson has 30 years of experience in the remediation, environmental and construction industries with specific experience in field operations, project and operations management and estimation. Anson is specifically responsible for project execution within the remediation division.

Mr. Anson specific experience includes river and lake sediment remediation, radioactive material handling, MGP remediation, wetland construction and restoration, land-fill capping and cell construction, demolition, solidification and water treatment, under water liner cap installation, sheet piling installation, and Sed-Vac excavation both wet and dry applications.

Previous to joining Terra, Anson spent 20 years within the remediation, environmental and construction industries functioning in various capacities from a laborer up through project manager. He has been a skilled equipment operator in a variety of settings including excavation, foundry, nuclear power plants, road construction, sewer/pipeline and both residential and commercial excavation construction. He has also owned and operated his own excavation company for 10 years where he had full management, operational and estimating responsibilities.

The Project Manager will be responsible for the overall project. He will be responsible for managing the day-to-day construction activities on the project. He will communicate directly with the client and with GLDD's senior management. His specific responsibilities include:

- Provide centralized leadership for all project activities
- Responsible for all field operations
- Ensure that work is performed in accordance with the client's specifications, industrial standards, and all applicable regulatory requirements
- Approve work products, plans, and deliverables
- Have overall responsibility for preparation and planning of documents for the work
- Respond to resource requirements by defining resource needs and securing the commitments for staff and equipment
- Develop, review, and meet work schedule and budget objectives
- Prepare for, and attend, meetings as required
- Provide guidance to personnel working at the project site
- Maintain daily contact with Operations Manager and the off-site support personnel, informing them of the project status

Site Superintendent – Mr. John Paal

The Site Superintendent for the Passaic River project is Mr. John Paal. Mr. Paal has more than 15 years of experience supervising and managing field, technical, and subcontractor personnel in operations involving marine and revetment construction.

GLDD's Site Superintendent will lead field efforts as necessary for the project work. His responsibilities include, but are not limited to:

- Oversee all aspects of the project work
- Ensure that the completed work achieves the performance requirements
- Coordinate with the Project Engineer to ensure adequate implementation of the project QA/QC requirements
- Report progress of site work to the Project Manager
- Interface with the Health and Safety Officer to ensure proper work methods are deployed and appropriate personal protective equipment is used

Site Safety Officer – Mr. Jeff Krug

Mr. Krug is responsible for implementing training programs on-site and informing employees on safety procedures and accident protection and prevention. He is responsible for ensuring site personnel are following the proper safety procedures and are wearing the appropriate safety equipment. He oversees site daily site inspections to ensure compliance with established regulations and company guidelines.

GLDD's Site Health and Safety Officer will be responsible for implementation of GLDD's site-specific Health and Safety Plan (HASP). His specific responsibilities include:

- Ensure site personnel possess necessary training and medical surveillance
- Conduct daily safety meetings
- Establish work zones and relocate zones as necessary
- Determine personnel protective equipment requirements for specific work tasks and order any changes based on work area monitoring data
- Ensure work is performed in compliance with GLDD's HASP, applicable regulations and Incident and Injury Free (IFF) work place practices.
- Implement air monitoring program and report data to the client
- Perform routine safety inspections
- Report and investigate any accidents or incidents
- Update work progress to GLDD's corporate health and safety manager

Project Engineer – Joe Miller

Mr. Miller is responsible for the management and scheduling of all site engineering activities in support of Capping operations. He is responsible for the final quality control and quality assurance verification of all engineering deliverables to include: hydrographic survey data collection, land survey data collection, bathymetry maps, topography maps, cross sections, volume calculations, daily construction reports, and daily dredge production analysis.

GLDD's Project Engineers will be responsible for engineering controls including:

- The development of the engineering project layout,
- Update capping operational plan,
- Update construction staking, barge positioning and status tracking.
- Update installation, operational status, and quality assurance checks on the RTK-GPS positioning systems for the material handler, deck barged, material barges, and any other positioned equipment on site.

Project Executive – Tom Cnudde

Tom Cnudde is the Project Executive. In that role, Tom is engaged with our project team as a senior level resource for both business and technical issues. He will also be available to CH2M Hill in the event that there are any issues that might arise that should require the attention of senior management above the project level. Tom will also engage with CH2M Hill and our team in events such as safety summits, major project reviews and other times as needed. He is currently the General Manager of TerraSea, which was a key entity established by GLDD specifically for the purpose of pursuing projects of this nature.

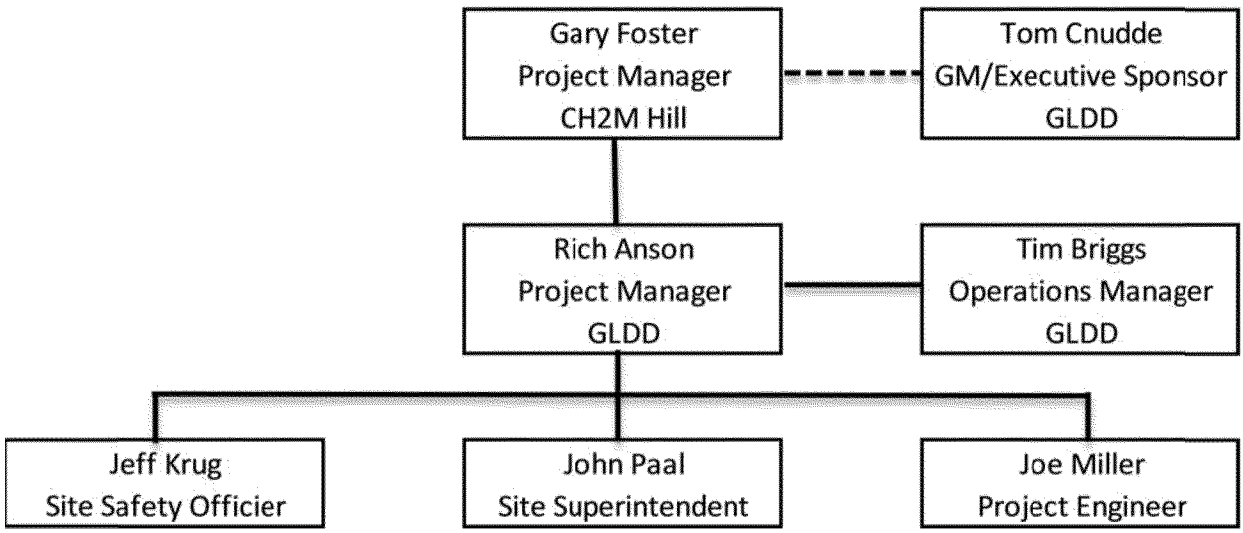
Operations Manager – Tim Briggs

Tim Briggs is an employee of GLDD and is currently serving as the Operations Manager of TerraSea. He will be Rich Anson's direct line into GLDD, including securing any support that may be required either domestically or internationally. Tim brings over 30 years of diversified experience in the environmental field including dredging, capping, sediment processing and stabilization. His resume highlights experience at some of the most complex sites completed in the U.S.

2.3 Project Organizational Chart

The project organization for the Capping Phase on the Passaic River RM 10.9 Project is presented below.

FIGURE 1
LOWER PASSAIC RIVER RM 10.9 PROJECT
PROJECT ORGANIZATIONAL CHART
CAPPING PHASE



3.0 Mobilization/Site Set Up

GLDD is currently mobilized to the site with the modified dredge barge, the geotextile deployment barge and material barges. The Revised Capping Plan requires modifications to the geotextile deployment barge for the implementation of the revised plan with two geotextile deployment methods. These modifications include:

Sinking Bar Method

1. Installation of a sink bar assembly on the front of the geotextile deployment barge
2. Installation of a roll support assembly with a break mechanism
3. Installation of a barge fleeting winch
4. Installation of winch anchor system
5. Mobilization of a small 10' x 40' sectional barge

Structural Panel

1. Mobilization of a crane
2. Transfer the RTK-GPS system to the Crane
3. Fabrication of a structural frame assembly
4. Installation of a barge fleeting winch

Once all specialized capping equipment has been installed, GLDD will continue with re-mobilization activities including:

1. Providing the bridge operators/engineers with a mobilization schedule inclusive of a bridge opening request schedule.
2. Calibration and Turbidity Buoy Deployment – If turbidity monitoring continues to be required by EPA during the installation of the geotextile and armoring stone, GLDD will install the four turbidity monitoring buoys at the specified WQMP locations with the installation of the 5th mobile buoy in a position that is dictated by the location of the turbidity barrier.
3. Inspection of the Barge Mooring Anchor Installation - GLDD has installed two material barge mooring anchors and floats at the designated equipment mooring location used for the dredging portion of the work. These anchors will be inspected prior to re-start of operations.
4. Turbidity Barrier Installation- GLDD will inspect the turbidity barrier system for compliance with the Water Quality Management Plan and make necessary repairs if required.

4.0 Capping Materials

The capping of the dredged areas consists of the installation of four distinct layers:

1. Sand/AquaGate+PAC™ Blend.
2. Geotextile
3. Armor Stone
4. Habitat Layer.

The Sand/AquaGate+PAC™ Blend layer has already been installed. The previous attempt to place the geotextile and armor stone has left some rock on the area that needs to be capped with geotextile. Section 5.2 of this plan addresses the removal of previously placed armor stone and cap repair. After the stone is removed and the cap is repaired (if damaged), the geotextile can be installed and the cap can be completed. The cap layers remaining for installation includes the geotextile, armor stone and habitat layers.

The following is a description of each remaining layer to be installed from lowest to highest layer. The remaining layers are as follows:

- Geotextile - Following the installation of the sand/AquaGate+PAC™ layer, GLDD will install a single layer of non-woven 100% plastic high strength dimensionally stable geotextile. The geotextile will be sewn into panels two or three rolls wide and stored at the GLDD Staten Island yard.

Opening size, permittivity, UV resistance, and strength properties must meet the following Geotextile Properties and Applicable Standards:

Property	Test Method	Units	MARV
Grab Strength	ASTM D 4632	N	1400
Sewn Seam Strength	ASTM D 4632	N	1260
Trapezoidal Tear Strength	ASTM D 4533	N	500
Puncture Strength	ASTM D 6241	N	2750
Permittivity	ASTM D 4491	sec-1	0.5
AOS	ASTM D 4751	mm	0.5
UV stability (retained strength)	ASTM D 4355	percent	50 (after 500 hours)

GLDD is currently sourcing two roll wide geotextile panels for use on the project. These panels use a Crown Resources Style E120 nonwoven geotextile fabric. A copy of the specification sheet for this material has been attached as Appendix A.

- Armor Stone - Following the installation of the geotextile, GLDD will install a layer of armor stone to deter erosion of the previous layers installed. The armor material will be clean, hard, angular, durable imported material that is free from foreign materials with the following physical properties:

  - Bulk specific gravity (SSD) > 2.65
  - Absorption < 2 percent
  - Resistance to Freezing and Thawing, maximum loss < 10 percent
  - Resistance to Wetting and Drying, maximum loss < 1 percent

Required performance evaluation tests on stone samples have been conducted under the direction of a registered geologist or engineer. All tests will be subjected to:

- Petrographic examination (ASTM C295)
- Bulk specific gravity (SSD)
- Absorption (ASTM C 127)
- Resistance of stone to freezing and thawing (ASTM D 5312)
- and if argillaceous limestone and sandstone are used, resistance to wetting and drying (ASTM D 5313) to meet the above requirements

Required Gradation (as determined in accordance with ASTM D5519).

- Type A Armor - average thickness of 12-inches and to minimum thickness of 10-inches.
- Type A Limits of Stone Weight (lb) for Percentage Lighter by Weight

100% lighter by wt.		50% lighter by wt.		15% lighter by wt.	
Max.	Min.	Max.	Min.	Max.	Min.
23 lbs.	9 lbs.	7 lbs.	5 lbs.	3 lbs.	1 lb.

- Type B Armor - average thickness of 6-inches and to minimum thickness of 4.5 inches.
- Type B Limits of Stone Weight (lb) for Percentage Lighter by Weight

100% lighter by wt.		50% lighter by wt.		15% lighter by wt.	
Max.	Min.	Max.	Min.	Max.	Min.
2 lbs.	0.8 lbs.	0.6 lbs.	0.4 lbs.	0.3 lbs.	0.1 lb.

Testing results from the armor stone source have been provided and have been approved for use at the site.

- Sand Habitat Layer - Following the installation of the Armor Stone layer, GLDD will install sand with the identical properties as the sand used in the sand/active material layer, without the AquaGate+PAC™ . The sand will be installed to fill voids within the installed armor stone resulting in a smooth surface that just covers the armor stone.

5.0 Capping Operations

The following sections describe the operational approach to be utilized for the installation of the geotextile, armor stone and habitat cap layers as well as the engineering controls to be employed.

5.1 Turbidity Curtains/Controls

All capping activities will be conducted, in accordance with the approved WQMP, using acceptable Best Management Practice (BMP) to manage potential re-suspension during capping operations. The silt curtain systems will be flexible and adaptable to both the environmental conditions of the river as well as all activities associated with capping. These silt curtains will be constructed of PVC sheeting that is weighted on the bottom and suspended from marine-quality flotation boom. Ballast chains/weights will be connected to the curtains via shackles or hooks and aluminum extrusion end connectors will be

adjoined and toggle pins inserted. Finally, the grommet eyes of each curtain section will be adjoined to the adjacent curtain to render the curtain continuous beneath the water.

The curtains will be installed as per the manufacturer's recommendations that include deployment with curtain sections retracted (furled/reefed up) once sections have been connected. The terminal ends of the silt curtain will be anchored at the shoreline using concrete ballast blocks and/or tie off points and secured in the river using anchored pontoons. The installed curtain will be continuously monitored for effectiveness and damage.

In addition to the silt curtain system, turbidity will be continued to be monitored per the approved WQMP and following Best Management Practices (BMP) will be employed during the capping operations:

- Monitor the river velocity/curtain behavior and suspend operations should the turbidity monitoring instruments exceed the allowable prescribed parameters. The installed curtain also demonstrates a safety factor for the allowance of storm events that will typically increase current flows
- Low energy placement of materials
- No "re-handling" of material on the river bottom
- Avoid grounding of marine vessels and allowing water levels to rise before attempting to free grounded vessels
- Minimize the number of trips by support vessels
- Restrict the draft of workboats and barges
- Restrict navigational speeds
- Restrict the size and power of workboats and restrict throttle speeds in the Capping Area
- Monitor the water quality beyond the silt curtains during capping operations

5.2 Removal of Previously Placed Armor Stone and Cap Repair

The initial geotextile and armor stone installation was not successful and all of the geotextile that was installed has been removed. However, some armor stone remain on top of the existing Sand/AquaGate+PAC™ layer. Prior to installing geotextile in these areas, the armor stone will be removed and if necessary, the Sand/AquaGate+PAC™ layer where the geotextile has been placed will be repaired.

GLDD will use a rock sifting rake, or similar device, for the removal of the armor stone and repair of the Sand/AquaGate+PAC™ layer. See Figure 2 a photo of the rock sifting rake.

The area where the geotextile and armor stone was previously installed will be inspected and the locations of the armor stone will be recorded with GPS position. These inspections will be both visual and by probing the bottom with a metal rod in areas that are not exposed during low tide.

Once the locations of the armor stone have been established, the rock sifting rake will be attached onto either the long reach excavator or material handler. The rock sifter will then gently remove the armor

stones and place the stone on the material barge for reuse. After the armor stone has been removed the rake attachment will be used to smooth the surface disturbed area, being careful not to go beyond the sand/active material layer.

Figure 2 – Rock Sifting Rake

The disturbed area will then be cored to verify that the Sand/AquaGate+PAC™ layer meets the minimum thickness requirement of 8-inches. If the core results show that the minimum thickness has not been maintained, additional Sand and AquaGate+PAC™ will be installed to meet the minimum thickness requirement of the specification.

In the event that the core samples show that the minimum thickness is not met the crane or material handler, equipped with RTK-GPS positioning system, will be used to place additional Sand and AquaGate+PAC™ for the repair. Based on the core results, the required thickness for the repair layer will be determined. To place the required added material to meet the minimum thickness requirement, the repair area will be gridded and size of the grids will be adjusted with DREDGEPACK to control the placement of the Sand and AquaGate+PAC™ . To meet the 30% (v/v) mixture requirements, the Sand and AquaGate+PAC™ will be mixed with the material handler bucket in the material barge, using 2 parts sand and 1 part of AquaGate+PAC™.

5.3 Geotextile and Armor Stone Installation

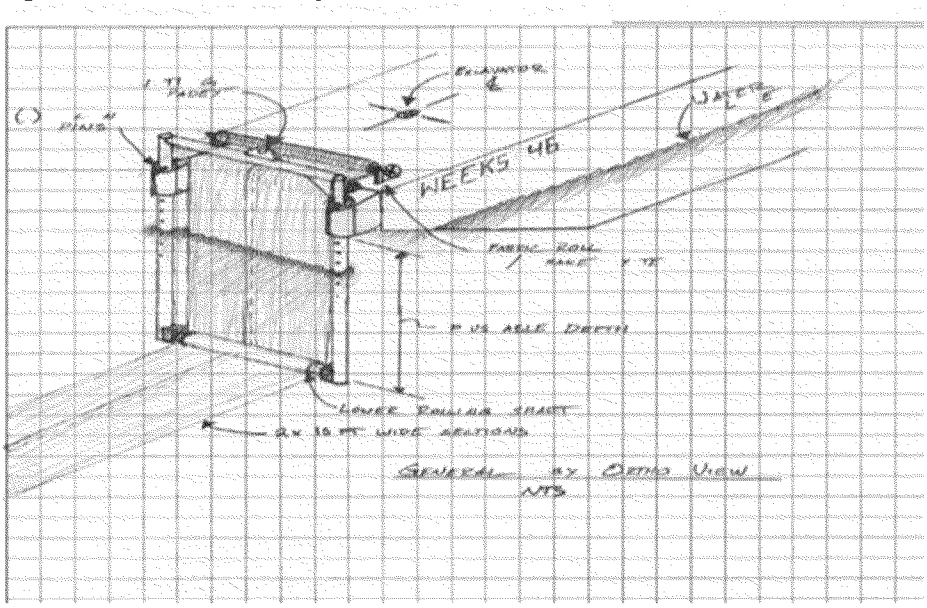
GLDD is planning to potentially use two different methods to deploy geotextile. One method will be the use of the sinking bar method that rolls the geotextile out along the bottom. The sinking roller assembly, supported from a geotextile barge, will move over the cap area using winches and anchors. The anchors used in this method will be located outside the cap area.

The second method is the structural panel method that uses a structural frame to place the geotextile fabric into position. With the panel method, either a spud barge will be anchored outside the cap area to position the crane and geotextile barge, or a winch and anchor system will be used. In both methods, neither anchors nor spuds will be allowed to penetrate the Sand/AquaGate layer.

5.3.1 Sinking Bar Method

GLDD will install a single layer of non-woven geotextile over the targeted cap area using an underwater placement technique that provides improved control of the geotextile deployment and positioning. Due to tidal and current conditions, GLDD proposes to install the geotextile layer and armor stone in unison so as to immediately ballast the material. The geotextile material will be installed using a sink bar for the underwater deployment of the geotextile fabric. The sink bar assembly will be positioned on the front of the geotextile deployment barge and will consist of a frame to hold the geotextile roll underwater near the bottom, a break to control the release of the fabric from the roll, and an adjustable depth sink bar. Figure 3 shows a conceptual sketch of the sink bar assembly.

Figure 3 Sink Bar Assembly



To deploy the geotextile fabric, a geotextile deployment barge, the modified dredge barge (modified to work on winches and anchors) and rock barges will be used to support the equipment (either a crane or material handler) and materials on the water. The modified dredge barge will be positioned using winches and anchors that will be positioned outside the cap area. GPS will be used to align the edge roll on the geotextile barge with the edge of the previous placed roll to maintain the required minimum 18 inch overlap. The end of the geotextile roll will then be pulled to shore and the leading edge will be positioned with GPS to start the roll on shore with a minimum 18 inch overlap. Where site conditions allow, survey stakes will be installed on shore to assist in the positioning of the geotextile fabric. In areas along the shore where there is truck access available, a truck with a winch (Ford F650 Boom truck or

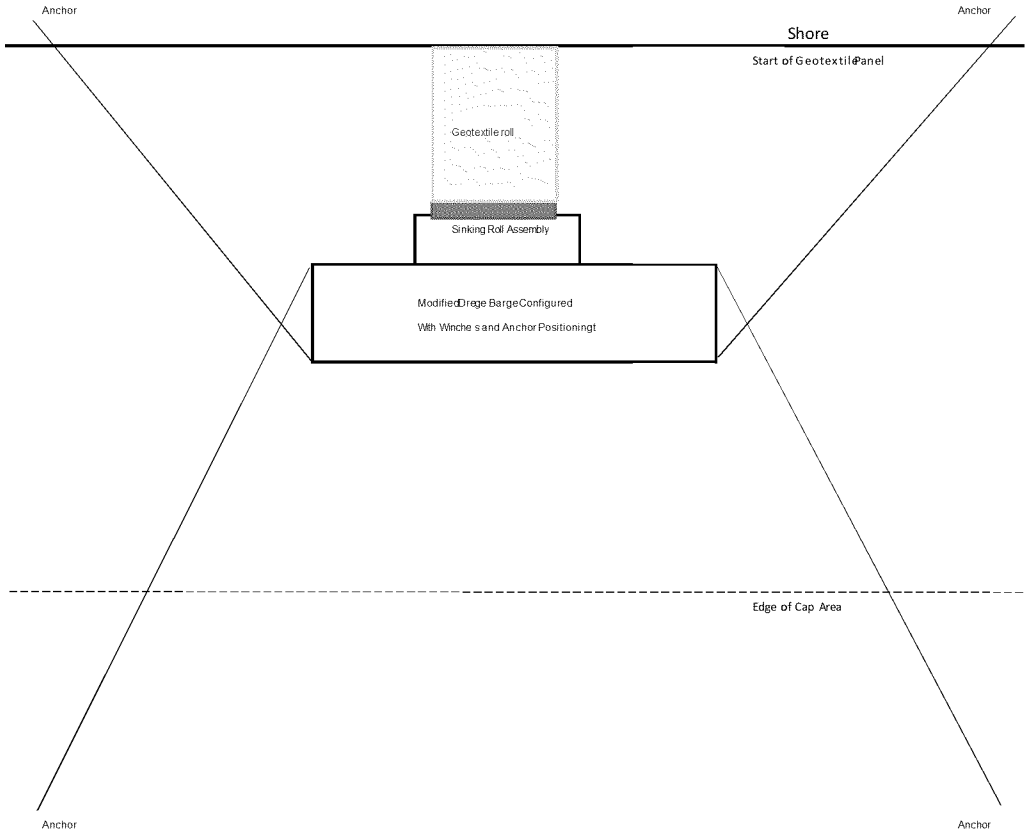
similar equipment) will be used to assist in pulling the geotextile fabric ashore. Areas where there is adequate draft and the geotextile can be placed from the water, the material handler will be used to position the geotextile panel along the shore. The edges of the fabric will also be marked with paint to show the 18-inch overlap and will also be aligned on shore with the edge of the previous roll on shore to establish proper alignment of the roll.

Once the geotextile has been aligned, armor stone will be placed, using the material handler, on the end of the geotextile to anchor the geotextile into position. Once the end of the roll has been anchored in position with armor stone, the material handler will start placing stone on the geotextile fabric. The armor stone will be placed to the required final thickness of 12 inches. To keep the overlap clear of stones and allow the next geotextile panel to overlap, armor stones will not be placed ~3 ft. from the edge of the roll.

As the stone is placed on the geotextile fabric the modified dredge barge will be moved away from shore using the winches and anchors. The GPS system on the modified dredge barge will be used to control the path of movement and keep the geotextile aligned. The geotextile barge can be repositioned along the modified dredge barge to fine tune the alignment of the geotextile fabric.

The sink bar assembly will place the geotextile near the bottom, to minimize the influence of the water currents on the fabric. As the geotextile deployment barge is moved away from shore toward deeper water, the depth of the sink bar will lowered to keep the geotextile deployed near the bottom. Figure 4 shows the conceptual layout of the barges while deploying the geotextile fabric.

Figure 4 SinkingRoll Barge Layout



To minimize the number of overlap seams between geotextile panels and to improve the placement of armor stone, the geotextile panels will be constructed two rolls wide. A preliminary panel layout, using the two roll panel design has been provided below as Figure 5.

Two types of Armor stone will be used on the project. 12 inches of Type A armor stone will be used to cap areas that were dredged to the full depth. For high sub-grade cap, 6 inches of Type B armor stone will be used. *Figure 6 – High Subgrade Areas* shows the locations of these areas. Also in Area 10 there were several rock outcroppings that will not get fabric or stone. See *Figure 7 – No Rock High Subgrade Areas.* All other areas that were part of the removal area and that are considered undercuts will receive fabric and smaller stone at smaller depths.

As stated above, the installation of the armor stone will occur concurrently with the installation of the geotextile. GLDD will employ the use of either the Fuchs 380 material handler or a crane to transfer the stone from the material barge to the targeted area on the geotextile. The stone will be placed in a controlled manner opening the bucket below the water line and a minimal distance above the geotextile thereby reducing the drop height. The operator will be provided additional guidance from the RTK/GPS system installed on the Fuchs 380 or Crane to assist in the installation of the specified layer thickness and location. As with the installation of the geotextile, lateral control will be maintained with use of the spud barge. At the completion of the armor stone installation the excess fabric visible during low tide will be trimmed.

Figure 5 Geotextile Panel Layout – Two Roll Width

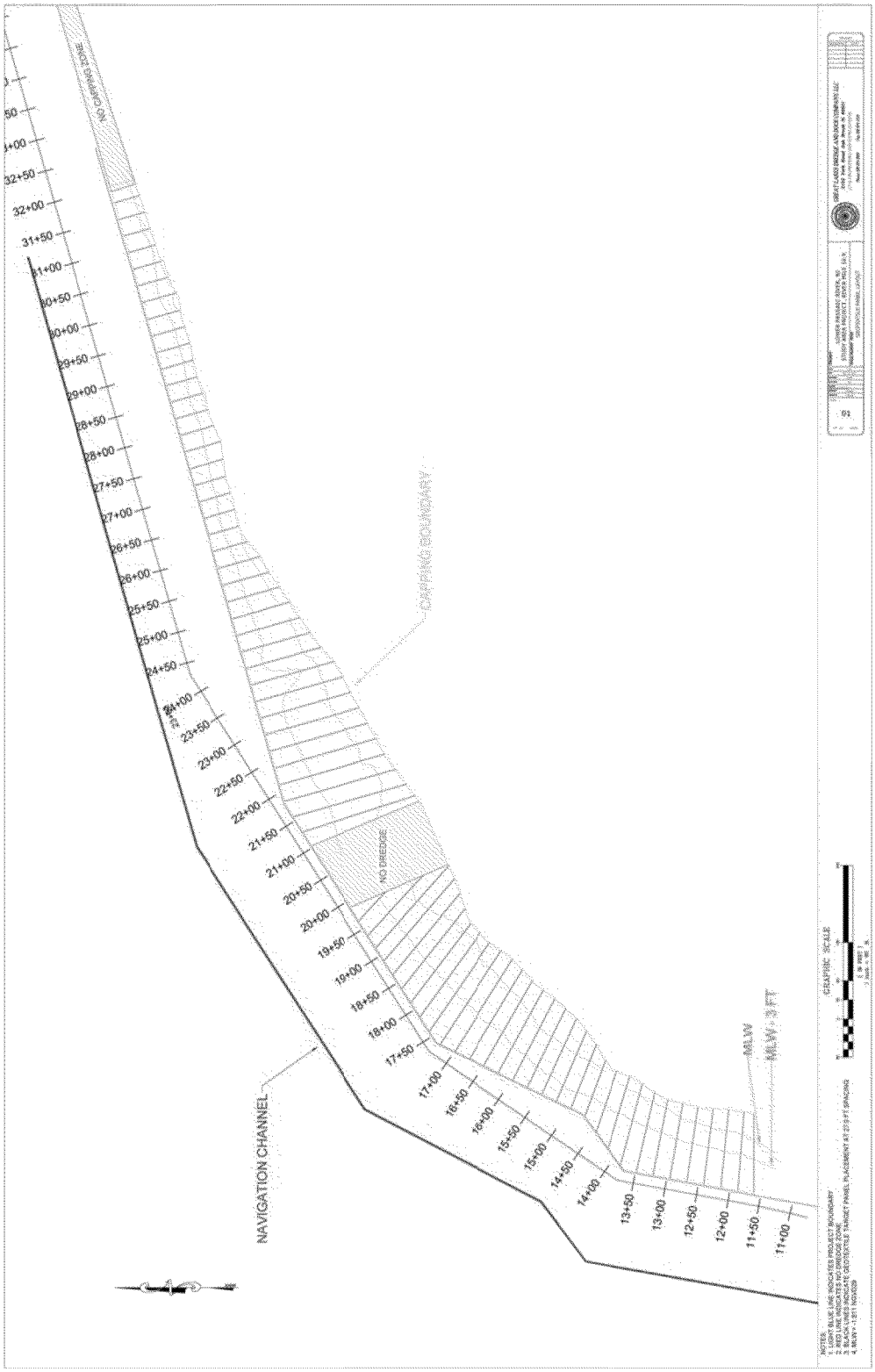


Figure 6 – High Subgrade Areas

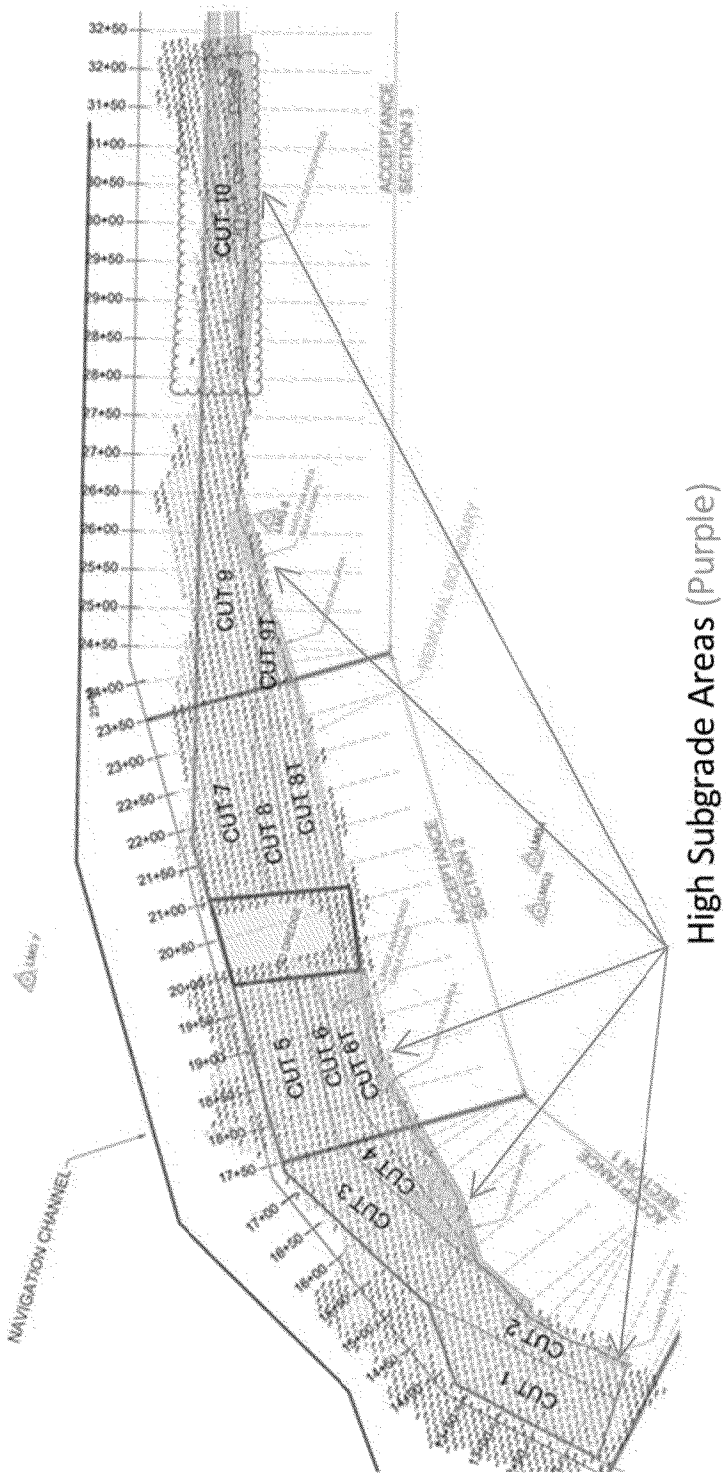
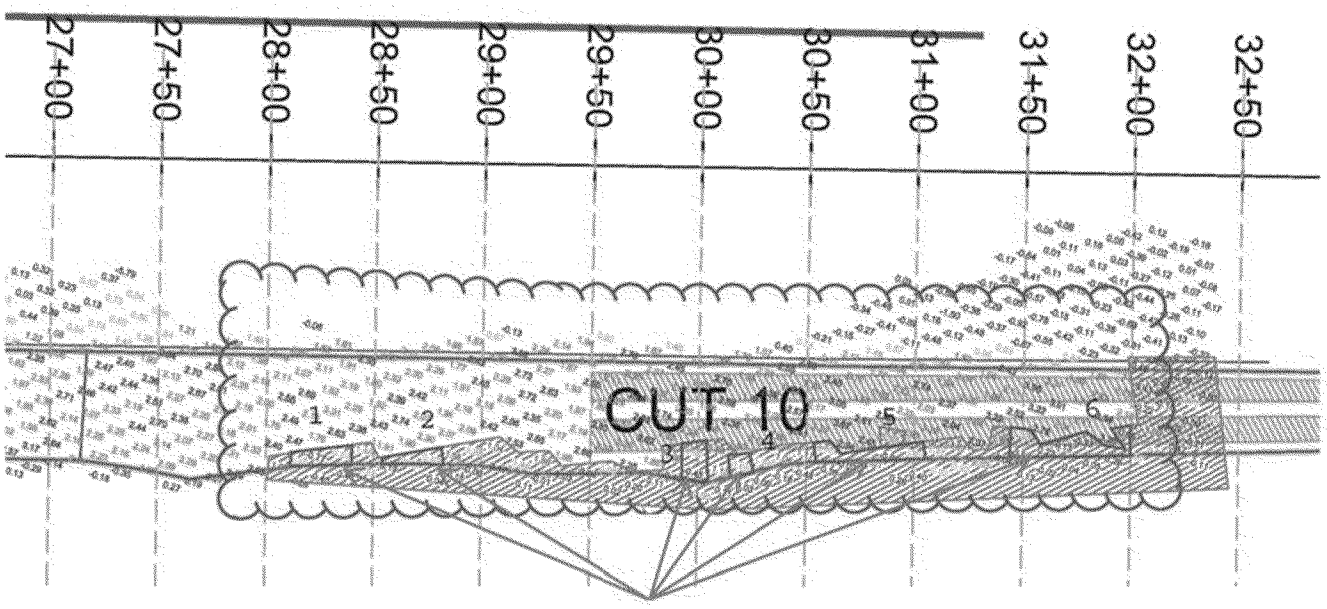


Figure 7 – Rock Outcroppings Areas



Rock Outcroppings (Blue)

5.3.2 Structural Panel Method

In addition to the sinking bar method described above, GLDD will potentially install the non-woven geotextile over the targeted cap area using a structural panel to place the geotextile fabric. With this method a structural frame is constructed to hold the fabric in position inside the frame. The frame is then lowered into position on top of the Sand/AquaGate layer and armor stone is added to ballast and anchor the geotextile fabric in position. Once the geotextile fabric has received the 12-inch thick armor stone layer the frame is pulled up and the geotextile fabric and armor stone remain in place.

The design of the structural frame has not yet been completed, however, GLDD envisions a 75 ft. x 30 ft. metal frame constructed from 10-inch pipe to be used as the geotextile panel frame. The geotextile panel would be secured to the frame with a low strength string that will easily break when the frame is removed.

The control of the geotextile overlap will be improved using this method. The structural frame will provide positive position control of the fabric, while the armor stone is placed on top of the fabric. In addition, the location of two corners of the frame will be recorded using GPS to verify overlap. The minimum overlap between upstream and downstream panels will be 18-inches as specified.

The approved Final Design Report specifies: *3.03 Geotextile Placement* - G. *"End of panel overlaps shall be sewn, stapled or hog ringed along each side of a 1foot."* Since the geotextile will not be placed in rolls and will be placed with a frame, this makes the sewing of overlaps impossible. GLDD requests that CH2M HILL obtain client and EPA concurrence to delete this requirement.

To allow for the geotextile to be overlapped and then covered with Anchor stone, GLDD proposes that the last three (3) feet of the exposed edge of the panel not be rocked until the adjacent panel has been positioned. This will allow for the geotextile from the adjacent panel to lay on top of the geotextile from the first panel, prior to being rocked.

To deploy the geotextile fabric using the structural panel method, a geotextile deployment barge, a crane barge and either a Spud Barge or the modified dredge barge (modified to work on winches and anchors) will be used. Either a crane or material handler and rock barges will be used to support the equipment and materials on the water.

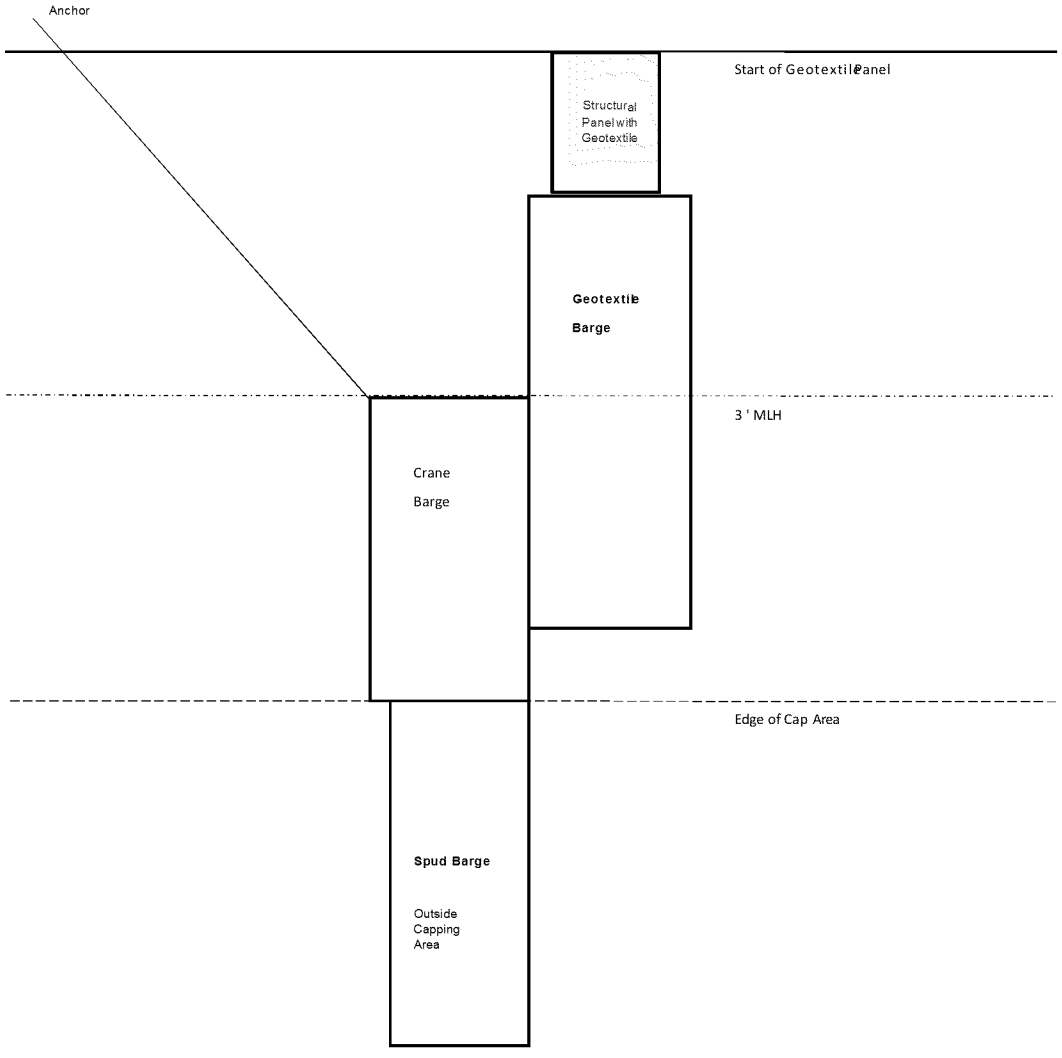
To position the crane and geotextile barges, the winches and anchors on the modified dredge barge are used. Whenever anchors are used the anchors will be located outside the cap area. In areas along the shore where there is truck access available, a truck with a winch (Ford F650 Boom truck or similar equipment) will be used as an anchor.

GPS will be used to align the edge of the geotextile barge. The edge of the geotextile barge will be used to assist in positioning the structural frame. Final positioning will be confirmed by locating the corners of the frame with GPS. After a panel of geotextile has been placed, the geotextile barge will be moved along the crane barge to the next frame position and the next panel will be placed.

Figure 8 shows a layout of the barges when the spud barge is used. When the spuds are used to secure the position the crane barge, the spuds will be located outside the sand/AquaGate Cap Area. Spuds or anchors will not be located inside the cap area.

Using this barge configuration with spuds, the crane barge is held in position by the spud barge (outside the cap area) and the crane barge spans the cap area without touching the cap. An additional anchor on-shore may be used to provide additional support.

Figure 8: Structural Frame Geotextile Deployment Method



A preliminary panel layout using the ~75 ft x 30 ft structural frame has been attached as Figure 9. This figure shows the 29 ft x 75 ft geotextile panels with a two (2) ft overlap on the edges, orientated with the long edge of the panels perpendicular to shore. Since we are placing the fabric using a frame compared to rolling out the fabric, we request some additional flexibility to allow a parallel to shore orientation. Figure 10 shows the same panel layout orientated with the long side parallel to the shore. As you can see there is little difference in orientation since we are placing the fabric in 29 ft x 75 ft panels.

Figure 9: Panel Layout Using 29 ft x 75 ft Panels, Orientated Perpendicular to Shore

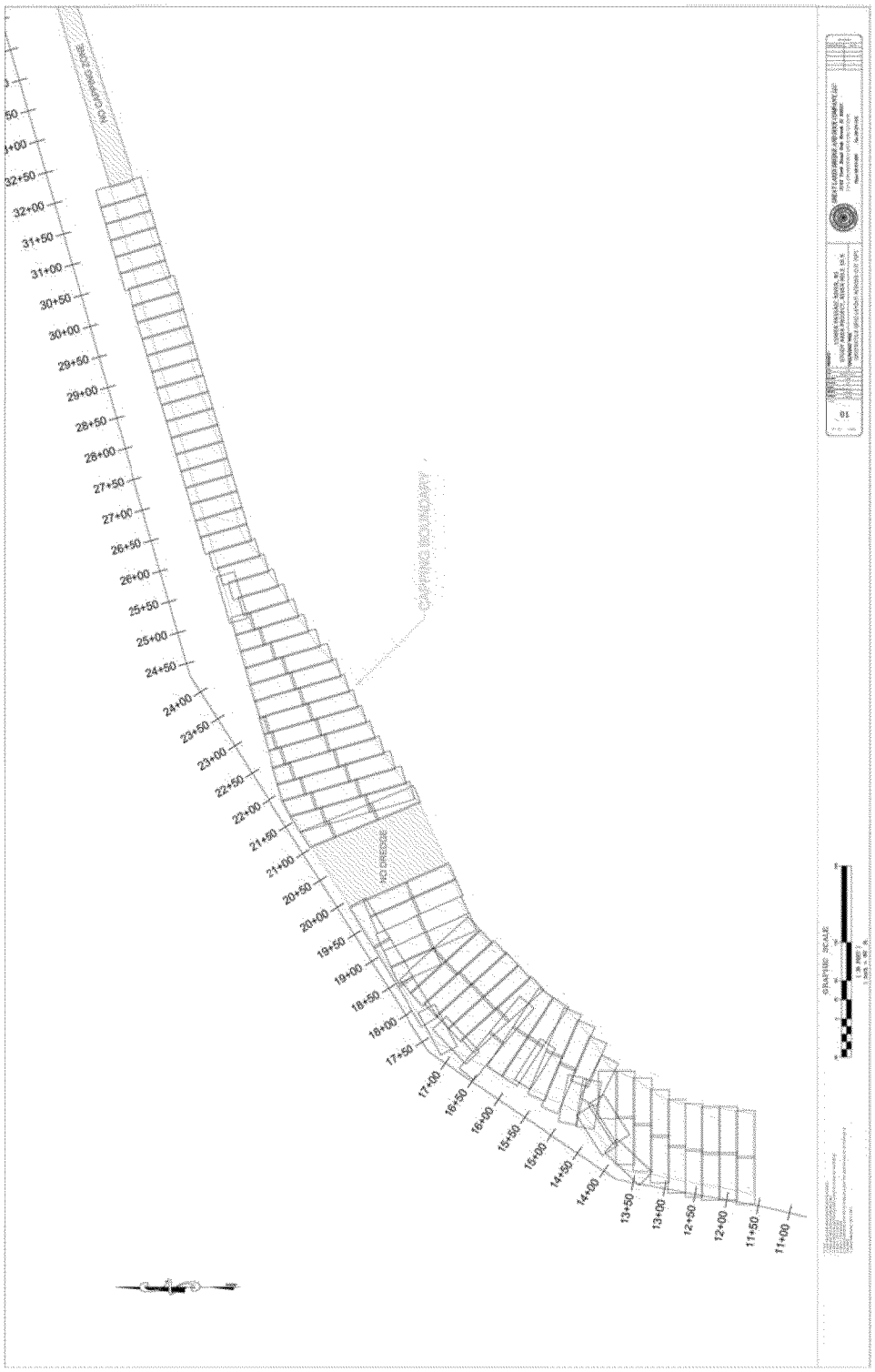
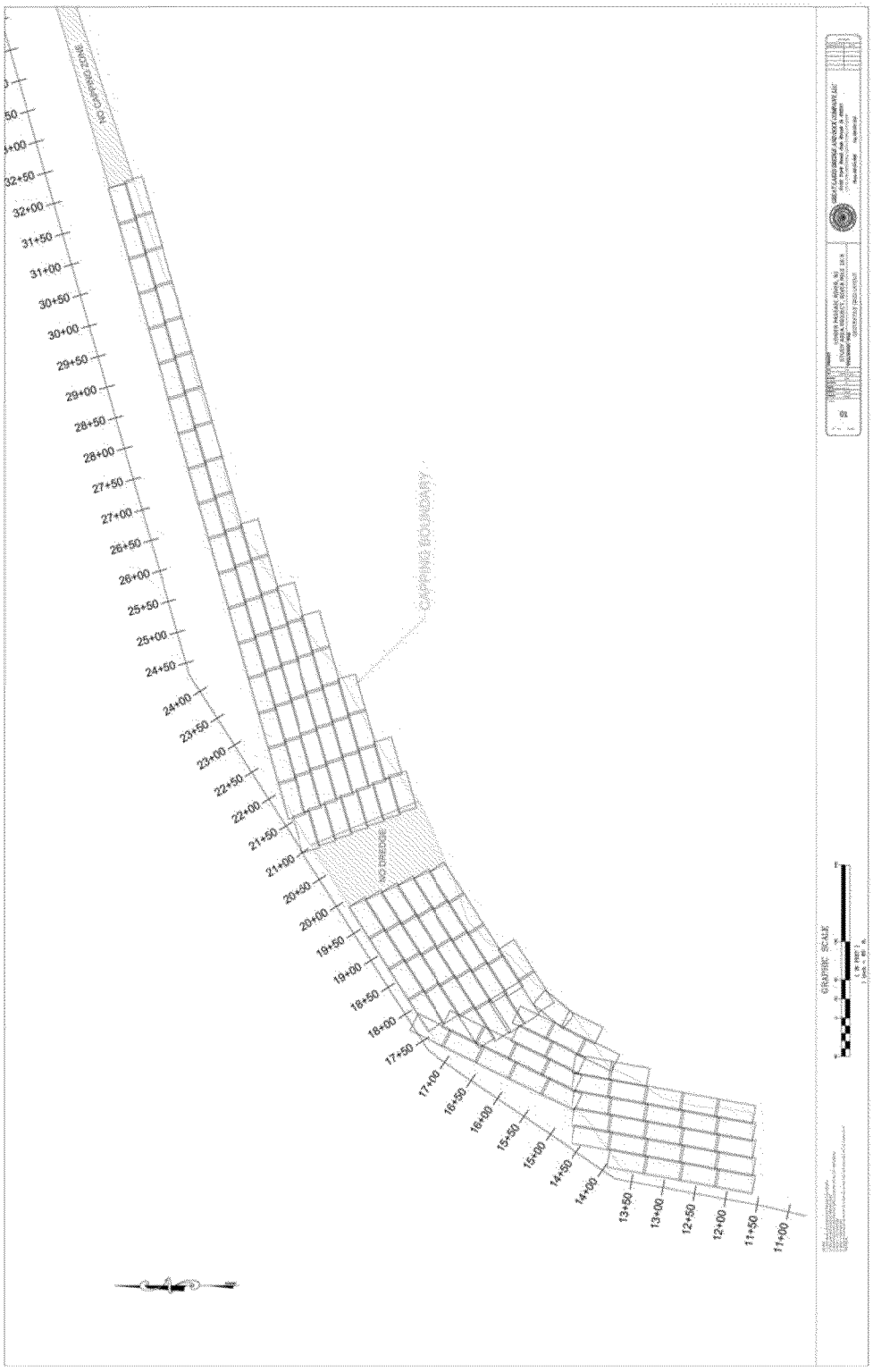


Figure 10: Panel Layout Using 29 ft x 75 ft Panels Orientated Parallel to the Shore



5.4 Habitat Sand Layer Installation

Following the placement and acceptance of the armor stone, GLDD will install an additional sand layer to fill voids within the armor stone resulting in a smooth surface. This layer will be installed utilizing the Telebelt system until a smooth surface is attained. As with prior layers, GLDD will utilize RTK/GPS to assist the operator in placement of the sand.

6.0 Capping Equipment Positioning

Positioning of the capping barge will be done using RTK GPS. Two independent systems will be used, one for positioning of the barge and one for the material handler/Telebelt. All positioning information will be fed to a positioning computer in the cab of the material handler to show the operator in real-time the position of the barge.

Boom and bucket/conveyor positions relative to the material handler/Telebelt will be monitored using a series of 5 ruggedized sensors, for use in capping applications. All positioning information will be interfaced with Hypack DREDGEPACK, the chosen software for the project. This software package will show the operator real-time the position of the barge, bucket and/or conveyor, and will allow for the operator to see real time multiple views of the capping operation with clear definition of existing and required fill levels.

A tide gauge will be installed on the project site to record and transmit tide levels and seamlessly update the positioning system to account for the variable water levels. The tide gauge will be used as a datum verification tool to continuously confirm proper operation of the RTK GPS vertical levels. Survey data and design capping elevations will be loaded into positioning software as surfaces that will guide the operator during capping. The following list details the positioning equipment to be utilized inclusive of function:

- Trimble SPS361 DGPS with Heading for Barge Positioning
  - GPS unit with radio package, antennas, mounting brackets, cabling, power, and enclosure to wirelessly transmit barge position to operator's cab.
- Trimble SPS855 GPS with Heading for Material Handler Positioning
  - Internal 450-470 MHZ Radio for RTK correction
  - 2 x GPS Antenna - Zephyr Model 2
- Positioning System Computer
  - Operator Viewing and Interface Computer
- Ruggedized angle sensors
  - Account for position of Boom, Stick, Bucket X, and Bucket Y
- Magnetic extension sensor
  - Accounts for relative bucket Open position measurement
- Barge/machine Pitch/Roll Inclinometer System
  - Accounts for lateral movement of barge & machine
- Bucket Rotation Monitoring System
  - Relative bucket rotation measurement using magnetic sensors
- Bucket Pitch/Roll Inclinometer System
  - 2 Ruggedized angle sensors

- Valeport Tide Gauge
  - Pressure transducer based tide monitoring system with radio telemetry

During the course of the project, several quality control checks of various parameters will be performed. Parameters within the quality control program include:

- Positioning systems will be checked each day prior to beginning capping
- An independent tide gauge will be installed near site to verify vertical datum levels
- Tide gauge will be checked and calibrated vs. survey staff / tide board daily
- Capping Operators will be informed daily of quality and performance of works based on data reviews
- All capping data will be automatically recorded and checked against survey data. Recorded data included, but not limited to:
  - XYZ Position of Barge
  - XYZ Position of Bucket
  - Tide level (pressure gauge & RTK levels)

7.0 Cap Thickness Verification Tests

GLDD will be performing the required bathymetric surveying. All surveys will be performed in accordance with USACE EM 1110-2-1003 Hydrographic Survey Manual by qualified GLDD Survey Engineering personnel using survey-grade positioning equipment and echo-sounders.

Check surveys will be performed on a daily basis and the results will be reviewed with Project Management team and equipment operators on a regular basis to ensure that capping tolerances are being met. Should any under or over-capping be observed, corrective actions will include immediate changes in cap installation thickness, followed by a re-survey to verify the results of any adjustments.

Placement of cap materials will be monitored as follows:

1. The thickness of the armor stone layer will be monitored during placement operations using the RTK-GPS positioning system on the material handler, by placing the lip of the bucket on top of the armor stone layer.
2. The armor layer thickness will be monitored and verified using settlement plates, installed.
3. Post-construction surveys will be conducted via bathymetric surveys and, as needed, by poling for verification of coverage.

GLDD proposes to use the following process to ensure stone layer thickness.

- Early in the start of fabric/stone placement, GLDD will install a settling plate constructed of 2'x2' plywood and 1" pipe with ability to extend to above water level.
- The plate will be installed on the installed fabric at a location that is outside the hardpan areas
- The length of pipe will be recorded and will extend above the water line. The top of pipe elevation will be recorded taking into account the length of pipe, thereby determining the elevation of the plywood plate.
- Stone will be placed on the plate in a slow/controlled manner. The top of stone will be recorded using the closed bucket tip of the material handler followed by the recording of the top of pipe elevation.
- The top of stone will be compared to the top of pipe (i.e. plate elevation) to arrive at 1' thickness of stone layer.
- The post stone installation top of pipe elevation will be compared to pre-stone installation top of pipe elevation, thereby determining the settlement of plate.
- This settlement determination will be applied to an area to be determined in the field.
- The Engineers have performed a post sand/AG survey that allowed them to create a top of stone elevation target. The top of stone target will be adjusted as per the settlement recording to create a total area target using the post sand/AG survey. This data will be loaded into the DREDGEPACK positioning program operating on the material handler so that the operator has guidance for stone installation.
- A final post fabric/stone installation survey will be performed following the completion of an area to be determined in the field.

The placement accuracy for and tolerance specifications of the armor layer will have been satisfied when the following statistical criterion is demonstrated based on post-armor layer and post-habitat layer placement measurements to be conducted by CH2M HILL:

Number of Samples Needed to Document Attainment of Minimum Thickness Requirement

Number of Samples Collected	Number of Samples Needed to Exceed Minimum Thickness	Number of Samples Collected	Number of Samples Needed to Exceed Minimum Thickness
11	11	21	20
12	12	22	21
13	13	23	22
14	14	24	23
15	15	25	23
16	16	26	24
17	17	27	25
18	17	28	26
19	18	29	27
20	19	30	28

Cap Layer Thickness Requirements:

Cap Layer	Minimum Thickness (inches)	Minimum Average Thickness (inches)	Maximum Average Thickness (inches)
Combined Sand/Active	8	10	N/A
Armor – Type A	10	12	N/A
Habitat	Cover armor stone	N/A	N/A
Total Cap Layers (Combined Sand/Active + Armor + Habitat)	N/A	N/A	24

Modified Cap Layer Thickness Requirements (High Subgrade Areas):

Cap Layer	Minimum Thickness (inches)	Minimum Average Thickness (inches)	Maximum Average Thickness (inches)
Combined Sand/Active	4	6	N/A
Armor	4.5	6	N/A
Habitat	Cover armor stone	N/A	N/A

At the conclusion of the capping, all capped areas will have been surveyed in conjunction with the PLS allowing for as-built drawings to be generated by GLDD with the NJ licensed/registered surveyor's approval.

The following list of equipment will be utilized for the performance of the surveying:

Positioning

- Horizontal & Vertical: Trimble SPS855 RTK Receiver

Soundings

- Single Beam, High Frequency – 200Khz
- ODOM Hydrotrac Echo sounder

8.0 Work Hours

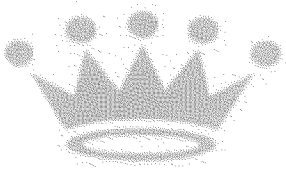
The placement of the geotextile and armor stone is restricted by the tides. GLDD proposes to schedule the work hours to take advantage of the tides. This will mean daily changes to the start and stop time on each work day, and will be communicated a week in advance. As a result operations will not be limited to daylight hours. During nighttime operations, light plants will be used to provide adequate lighting.

9.0 Demobilization

Following the completion of the capping operations, all equipment utilized for the performance of the work will be demobilized and transported to their respective origins for dismantling and/or return to inventory/vendor.

Appendix A

Crown Resources



2694 Hayes Wilbank Road
Toccoa, GA 30577
(864)968-0592

Geotextile Product Description Sheet

Style E120

E120 is a nonwoven geotextile produced by needlepunching synthetic staple fibers in a random network to form a high strength dimensionally stable fabric. The polypropylene fibers are specially formulated to resist ultraviolet light deterioration, and are inert to commonly encountered soil chemicals. The fabric will not rot or mildew, is non-biodegradable, and is resistant to damage from insects and rodents. Polypropylene is stable within a ph range of 2 to 13. E120 conforms to the physical property values listed below:

Fabric Property	Test Method	Units	Minimum Average Roll Value
Weight	ASTM D 5261	oz/sq.yd.	12.0 (408 g/sm)
Thickness*	ASTM D 5199	Mils	120 (3.05 mm)
Grab Tensile	ASTM D 4632	lbs.	350 (1.56 kN)
Grab Elongation	ASTM D 4632	%	50
Trap Tear	ASTM D 4533	lbs.	125 (.556 kN)
CBR Puncture	ASTM D 6241	Lbs	900 (4.0 kN)
Permittivity*	ASTM D 4491	1/sec	0.758
AOS	ASTM D 4751	U.S. Sieve	100 (.150 mm)
Permeability*	ASTM D 4491	cm/sec	.30
Water Flow*	ASTM D 4491	gpm/sqft	60 (2290 1/min/sm)
UV Resistance after 500 hrs.	ASTM D 4355	% Strength Retained	70
Packaging			
Roll Dimensions-Feet			15 x 480
Square Yards Per Roll			800
Estimated Roll Weight-Lbs.			620

* At time of manufacturing, handling may change these properties.

To the best of our knowledge, the information contained herein is accurate. However, Crown Resources cannot anticipate all conditions under which the product information and our products, or the products of other manufacturers in combination with our products, may be used. We accept no responsibility for results obtained by the application of this information or the safety or suitability of our products either alone or in combination with other products. Final determination of the suitability of any information or material for the use contemplated, of its manner of use, and whether the suggested use infringes any patents is the sole responsibility of the user.

2012

TMGP

January 3, 2014

IWT Cargo guard
Attn: Pete Daly

Pete,

Terra Marine Geo Products is an authorized distributor and converter of seamed panels for Crown Resources. The Crown Resources E120 roll goods will be converted to sewn panels per the spreadsheet received with dimensions for North Zone Panels N1 thru 40 and South Zone S1 thru 31. Terra Marine Geo Products will convert sewn panels of (E120) 12 oz non-woven geotextile sewing method double lock stich meeting the 1260 N per ASTM 4632.

Please let me know if you have any questions.

Michael Geis
Operations Manager
TerraMarine Geo, LLC